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(54) **Residual-ink detector and a liquid injection recording apparatus comprising the detector**
Detektor für übriggebliebene Tinte und Flüssigkeitseinspritzregistrierapparat mit diesem Detektor
Détecteur d'encre résiduelle et dispositif d'enregistrement par injection de liquide ayant ce détecteur

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DE-B- 1 773 167 **US-A- 4 014 213**

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Description

Field of the Invention

This invention relates to an ink remain detecting apparatus operated by a variation in pressure and a liquid injection recording apparatus provided with the detecting apparatus.

Related Background Art

The liquid injection recording apparatus is usually called an ink jet recording apparatus, and is designed such that ink in a plurality of ink discharge ports provided in a recording head is driven on the basis of recording information, whereby flying ink droplets going from the ink discharge ports toward a recording medium are formed to record images, characters, etc. on the recording medium.

In the recording apparatus of this type, an ink ribbon or the like is not used, but liquid ink stored in an ink tank is supplied to a recording head through an ink supply path formed by a tube or the like and is caused to fly as minute liquid droplets to a recording medium by the discharging mechanism of the recording head and adhere to the recording medium to thereby accomplish recording.

Accordingly, unlike an ink ribbon type recording apparatus, to prevent unsatisfactory recording caused by the shortage of ink, a construction is generally adopted in which a device for detecting the amount of remaining ink in the ink tank is provided and when the amount of remaining ink has become insufficient, an alarm sound or the like is generated to thereby urge the operator to supply ink or interchange the cartridge type ink tank.

Figures 1A and 1B of the accompanying drawings show the construction of the essential portions of liquid injection recording apparatuses which are suitable for applying the present invention.

In Figure 1A, a recording head 1 is for discharging ink droplets to a recording medium having its recording surface regulated by a platen 8 to thereby accomplish recording, and is carried on a carriage 2 movable along a pair of guide shafts G installed parallel to the platen 8.

A sub-ink tank 4 is also carried on the carriage 2, and the ink in this sub-ink tank is supplied to the recording head 1 through a supply tube 3.

An ink tank 7 as an ink supply source is mounted on the body side of the recording apparatus, and this ink tank 7 and the sub-ink tank 4 are connected together by a flexible ink supply tube 5A. The ink tank 7 is constructed of a flat and flexible bag member formed of a sheet of plastic material or aluminum. An ink remain detector 6 is connected half-way in the ink supply tube 5A.

The flexible ink supply tube 5A is bundled with a flexible suction tube 5B from half-way thereof, and con-

stitutes a flexible communicating member 5 for absorbing the movement of the carriage 2.

The suction tube 5B connects a pump (suction means) 9 to the sub-ink tank 4 so that the liquid level in the sub-ink tank 4 is maintained within a predetermined range. Also, this pump 9 is connected to capping means 10 for hermetically sealing the recording head 1, and constitutes an ink recovering device for sucking the ink from the fore end (the ink discharge ports of the head 1) when recording is unsatisfactory or when the ink tank 7 is to be interchanged.

In the construction of Figure 1A, the ink stored in the ink tank 7 is directed to the sub-ink tank 4 on the carriage 2 through the ink remain detector 6 and the ink supply tube 5A. Further, the ink is directed from the sub-ink tank 4 to the recording head 1 through the supply tube 3, and is discharged from the ink discharge ports of the recording head on the basis of recording information, whereby recording is effected on the recording medium on the platen 8.

Figure 2 of the accompanying drawings shows a structure proposed as the ink remain detector 6.

In Figure 2, a flexible film member 13 is held between a body 11 and the joined surface of a cover 12, and the space in the body 11 provides an ink chamber 26 isolated from the atmosphere. The body 11, the film member 13 and the cover 12 may be jointed together by a suitable method such as bonding, welding or screw-setting.

The body 11 is formed with an ink inflow port 24 and an ink outflow port 25 for connecting the ink supply tube 5A (Figures 1A and 1B), and the ink chamber 26 which is a space partitioned by the film member 13 forms a part of an ink supply path.

The film member 13 is supported between a lower plate 14 and an upper plate 15.

The lower plate 14 is coupled to the lower end of a bolt 17 biased upwardly by a spring 16, and is normally held in its uppermost position as shown.

On the other hand, the upper plate 15 is slidably fitted to the bolt 17 and urged against a pair of electrodes 18 and 19 fixed to the back of the cover 12 with the lower plate 14 and the film member 13 interposed therebetween, by the spring force of the spring 16. The upper plate 15 is made of an electrically conductive material and may be urged against and separated from the pair of electrodes 18 and 19 to perform a switching operation as detector means.

The electrodes 18 and 19 are connected to lead-out terminals 20 and 21, respectively, provided on the cover 12.

A nut 22 is threadably engaged with the upper threaded portion of the bolt 17 so as to be adjustable in its vertical position, and the spring (compression coil spring) 16 is mounted below the nut 22 between a spring holder 23 and the surface of the cover 12.

Thus, by rotating the nut 22 and adjusting the position of the nut 22 on the bolt 17 by adjusting means which is screw means, the magnitude of the upward

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force of the spring 16 acting on the film member 13 can be adjusted, whereby the operation setting of the ink remain detector 6 can be adjusted.

In such a construction, when the amount of remaining ink in the ink tank 7 in the form of a hermetically sealed bag having at least a portion thereof formed of a flexible sheet decreases, the negative pressure in the ink supply path becomes strong, and in response thereto, the film member 13 is downwardly attracted against the spring force of the spring 16, and when a predetermined negative pressure value adjusted by the nut 22 is reached, the film member 13 lowers and the electrically conductive plate 15 separates from the pair of electrodes 18 and 19.

Thereby the lead-out terminals 20 and 21 are switched off (rendered non-conductive) and by the then variation in resistance value, it is detected that the amount of remaining ink has become less than a set value.

However, the conventional ink remain detector 6 of Figure 2 has sometimes given rise to the following problems.

If consumption of the ink is continued by the recording operation or by the using of the pump even after it is detected that the amount of remaining ink has become less than the set value, excessively great deformation occurs to the flexible film member 13 due to the excessively great negative pressure produced in the ink supply path, and this has led to the possibility that the operation setting pressure is varied and further the film member 13 is damaged.

Also, continued recording with the amount of remaining ink being null would adversely affect the recording head 1.

These inconveniences are liable to occur when the operator of the recording apparatus is absent in spite of the ink remain detector having operated during recording.

As means for preventing such inconveniences, it is conceivable to stop the operation of the recording apparatus when an output detecting that the amount of remaining ink has become small is produced from the ink remain detector.

However, this method suffers from the great possibility that the record becomes wasteful in the course of recording, and it has not always been a suitable method to carry out if the recording time and the amount of consumed ink are taken into account particularly when hard copies are being output in a color liquid injection recording apparatus.

Also, in Figure 1B, there is shown another form of the liquid injection recording apparatus provided with the ink remain detector described with reference to Figure 1A. The difference between the apparatus of Figure 1A and the apparatus of Figure 1B is that in Figure 1A, the ink remain detector 6 is connected to the ink supply tube 5A, whereas in Figure 1B, the ink supply tube 5A is communicated with the ink tank 7 and the ink remain detector 6 is communicated with the ink tank 7 dis-

cretely therefrom. Accordingly, the apparatus shown in Figure 1B need not be described in greater detail. Of course, in the case of Figure 1B, one of the outlets of the ink remain detector 6 is closed so that no ink may leak.

In the case of Figure 1B, any fluctuation of the pressure of the ink remain detector 6 is not transmitted to the ink in the ink supply tube 5A, and this leads to a good result in respect of stable recording and stable detection of the amount of remaining ink. However, even in the case of the form shown in Figure 1B, the above-noted problems have not been solved.

The DE-OS 33 44 447 among others shows a pressure detector for controlling the ink remain by a flexible film member having a curvature at a certain pressure ratio and, in doing so, releasing or interrupting a contact means firmly fixed to the pressure detector. In all embodiments shown therein the pressure detector is provided with only one contact means or basically only two switching positions have been provided for the pressure detector itself, respectively. Thus the functional principle of this known switch substantially corresponds to that of the prior art cited above.

The US-A-4 014 213 describes a further example of an accumulator warning system releasing an early warning signal when the gas pressure falls below a first gas pressure level and a further warning signal when the gas pressure falls below a second pressure level.

However, this warning system responds to the decrease of an over-pressure level on one side of the flexible diaphragm, whereby first an inner contact and subsequently an outer contact are closed. Herefor, both contacts are exclusively kept so as to be shifted against each other at the diaphragm and biased in one direction by a spring.

It is an object of the invention to provide a liquid injection recording apparatus provided with an ink remain detector, which is simple in structure and capable of accomplishing highly reliable and moreover effective and accurate detection of the amount of remaining ink.

According to the invention, this object is solved by an recording apparatus of this kind having the features according to claim 1 and by an ink remain detector having the features according to claim 16.

A recording apparatus according to the invention using a recording head for discharging ink toward a recording medium to thereby effect recording and an ink tank storing therein said ink to be supplied to said recording head comprising

an ink remain detector for communicating said recording head with said ink tank, said ink remain detector comprising an ink chamber having at least one wall surface formed by a flexible film member, wherein said flexible member carries a first detector means fixed relative to said flexible film member for switching a contact means in accordance with a pressurization in said ink chamber, said contact means being fixed relative to said ink chamber, and

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wherein said first detector means is in contact with said contact means until the pressure in the ink chamber reaches a first set negative pressure, and said first detector means is not in contact with said contact means upon deformation of said flexible film member when the pressure in the ink chamber reaches said first set negative pressure as the negative pressure in the ink chamber increases, a second detector means which comes into contact with stopper means limiting a further deformation of said flexible film member when the pressure in the ink chamber reaches a second set negative pressure as the negative pressure in the ink chamber increases.

An ink remain detecting apparatus according to the invention is provided with an inflow port, an outflow port and an ink chamber communicating with said inflow port and said outflow port and having at least one wall surface formed by a flexible film member,

wherein said flexible film member carries a first detector means fixed relative to said flexible film member for switching a contact means in accordance with a pressurization in said ink chamber, said contact means being fixed relative to said ink chamber,

wherein said first detector means is in contact with said contact means until the pressure in the ink chamber reaches a first set negative pressure, and said first detector means is not in contact with said contact means upon deformation of said flexible film member when the pressure in the ink chamber reaches said first set negative pressure as the negative pressure in the ink chamber increases, a second detector means which comes into contact with stopper means limiting a further deformation of said flexible film member when the pressure in the ink chamber reaches a second set negative pressure as the negative pressure in the ink chamber increases.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1A and 1B are perspective views showing the essential portions of liquid injection recording apparatuses which are suitable for applying the present invention.

Figure 2 is a longitudinal cross-sectional view of a conventional ink remain detector.

Figure 3A is a block diagram showing the construction of the essential portions of the liquid injection recording apparatus of the present invention.

Figure 3B is a flow chart showing the steps of the operation of the liquid injection recording apparatus shown in Figure 3A.

Figure 4 is a longitudinal cross-sectional view of an ink remain detector according to an embodiment of the present invention.

Figure 5 is a longitudinal cross-sectional view of an ink remain detector according to another embodiment of the present invention.

Figure 6 is a block diagram of a control system in a second embodiment of the present invention.

Figure 7 is a longitudinal cross-sectional view of the ink remain detector in Figure 6.

Figure 8 is a block diagram of a control system in a third embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will hereinafter be specifically described with reference to Figures 3 to 8.

(Embodiment 1)

Figure 3A is a block diagram of a control system in an embodiment of a liquid injection recording apparatus according to the present invention.

In Figure 3A, an ink remain detector 6 is mechanically connected half-way in an ink supply path 31 which connects an ink tank 7 to a recording head 1, and further the ink remain detector 6 has electrically connected thereto an ink remain alarm device 32 for informing that ink remains a little, a device 33 for stopping the recording operation and/or an alarm device 34 for indicating ink-shortage.

The ink remain alarm device 32 is a device for informing the operator in advance that the amount of remaining ink has become small and if recording is continued any further, normal printing will become impossible at a predetermined amount of recording.

Also, the alarm device 34 for indicating ink-shortage is a device for informing the operator that the amount of remaining ink is less than a predetermined amount and the negative pressure in the supply path has reduced to such a degree that normal printing is impossible and further that the recording operation has been stopped.

Thus, the ink remain detector 6 is provided with detector means for the two different alarm devices 32 and 34 operated at negative pressure and informing the operator that the amount of remaining ink has become small.

That is, in the present embodiment, the ink remain detector 6 is provided with detector means for the two different alarm devices 32 and 34 operated at negative pressure and informing the operator that the amount of remaining ink has become less than a set amount and that the amount of remaining ink has become so small that the negative pressure in the supply path becomes excessively great (abnormal) and the quality of print becomes inferior. Alternatively, the ink remain detector may be constructed of the two alarm devices, i.e., the ink remain alarm device 32 and the alarm device 34 for indicating ink-shortage, or an alarm device having those functions in one.

Figure 4 shows an embodiment of the ink remain detector provided with such two detector means.

The ink remain detector 6 of Figure 4 differs from the conventional ink remain detector 6 of Figure 2 in that stopper means 41 having a pair of electrodes 42 and 43 in the air-tight chamber of a body 11 is added, that a lower plate 14, like an upper plate 15, is formed of an electrically conductive material and that lead-out terminals 44 and 45 connected to the pair of electrodes 42 and 43, respectively, on the stopper means 41 are added onto a cover 12, and is substantially identical in the other points to the conventional structure of Figure 2. In Figure 4, portions corresponding to those in Figure 2 are given similar reference numerals and need not be described. In the present embodiment, as previously described, there are provided two detector means, i.e., first detector means comprised of electrodes 18 and 19 and the upper plate 15, and second detector means comprised of electrodes 42 and 43 and the lower plate 14.

Description will now be made of a preferred example in which an ink remain alarm and ink-shortage information and/or a detection output used to stop the recording operation are obtained by the use of the two detector means as shown in the present embodiment to thereby actually control the apparatus.

The stopper means 41 is for preventing any excessively great downward displacement of a film member 13 by negative pressure, and in the shown example, it is formed integrally with the body 11, and the pair of electrodes 42 and 43 are provided on the bearing surface thereof, i.e., the upper surface thereof against which the lower plate 14 bears. In the present example, the stopper member is formed in the ink chamber.

In the construction of Figure 4, when the amount of remaining ink in the ink tank 7 (Figure 1A) becomes small, the upper plate 15 of electrically conductive material is separated from the electrodes 18 and 19 by the negative pressure produced in the ink supply path (the ink supply tube 5A, etc.), as in the conventional structure of Figure 2), and the resistance between terminals 20 and 21 is varied.

These terminals 20 and 21 are connected to the ink remain alarm device 32, and the negative pressure value for which the resistance between these terminals is varied, i.e., the first set negative pressure value, is adjusted by a nut 22 so as to coincide with the intention of the ink remain alarm device.

If consumption of ink is further continued after the ink remain alarm device 32 is operated, the amount of displacement of the film member 13 increases with an increase in the negative pressure in the ink supply path and the electrically conductive lower plate 14 comes into contact with the electrodes 42 and 43 on the stopper means 41. Thereby, the resistance between another set of terminals 44 and 45 on the cover 12 is varied.

These terminals 44 and 45 are connected to the alarm device 34 for indicating ink-shortage and the device 33 for stopping the recording operation, and the negative pressure value for which the resistance between these terminals 44 is varied, i.e., the second

set negative pressure value, is adjusted by adjusting means so as to coincide with the intention of the alarm device 34 for indicating ink-shortage, that is, so that the force of a resilient member such as spring means which biases a flexible film in a direction to increase the volume of the ink chamber (the flexible film is in a substantially undeformed state) is adjusted.

The process explained above will be further described briefly with reference to the flow chart of Figure 3B.

When the main switch of the apparatus is closed (step 301), whether the detector means 1 is open is judged (step 302). If the amount of remaining ink is sufficient, the detector means 1 is closed and therefore, in such case, if there is provided informing means for indicating the presence of ink, this means indicates that ink fully exists (step 303). When ink is used and consumed, the detector means 1 opens its contact because the upper plate moves in conformity with the movement of the flexible film member. Thereupon, the judging function judges whether the detector means 2 is closed (step 304). If at this time, the detector means 2 is open, that is, both of the detector means 1 and the detector means 2 are open, it is possible to continue recording, but it is indicated that ink remains a little, in order to indicate that the amount of remaining ink has become small. If consumption of ink is further continued, the flexible film member is more deformed and the lower plate moves, whereby the contact of the detector means 2 is closed. When it is detected that the contact of the detector means 2 has been closed, it means that there is not left sufficient ink to continue recording and therefore, in accordance with this judgement, ink-shortage is indicated (step 306). Where the apparatus is provided with the automatic stopping function, the recording operation of the apparatus may also be stopped simultaneously therewith by the utilization of the result of this detection.

By providing a plurality of detector means (in this case, two detector means) in this manner, it is possible to easily indicate that ink fully exists, that ink remains a little, and ink-shortage, and it is also possible to automatically stop the recording operation of the apparatus on the basis of the result of the detection by these detector means.

If the liquid injection recording apparatus as shown in Figure 1A is constructed by the use of the ink remain detector 6 of Figure 4 as described above, there are obtained the following operational effects.

The operator of the recording apparatus is informed in advance that the amount of remaining ink has become small, and then is informed that the amount of remaining ink for which normal printing cannot be accomplished has been reached and therefore, effective and highly reliable detection of the amount of remaining ink has become possible.

Also, the recording operation is stopped when normal printing has become impossible and therefore, it has also become possible to eliminate bad influence

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upon the recording head 1 and the ink remain detector 6.

Further, the ink remain detector 6 conforming to the purpose of the liquid injection recording apparatus is provided by a simple construction in which the pair of electrodes 42 and 43 are provided on the stopper means 41 and therefore, it has become possible to provide a liquid injection recording apparatus of high reliability easily without making the apparatus bulky and costly.

Also, such information can be accomplished accurately by light-emitting means such as LED or an electric bulb, sound generating means such as chime, sound or piezo-electric buzzer, or display means such as liquid crystal or CRT, or a combination of these means.

(Embodiment 2)

Figure 5 shows another embodiment of the ink remain detector according to the present invention.

The ink remain detector 6 of Figure 5 differs from the conventional structure of Figure 2 in that a stopper 51 of electrically conductive material is added to the intermediate portion of the bolt 17 and a second pair of electrodes 52 and 53, in addition to a first pair of electrodes 18 and 19, are added between the upper plate 15 of electrically conductive material and the stopper 51 and that lead-out terminals 54 and 55 connected to the second pair of electrodes 52 and 53, respectively, are added onto the cover 12, and is substantially identical in the other points to the conventional structure of Figure 2. In Figure 5, portions corresponding to those in Figure 2 are given similar reference numerals and need not be described.

The stopper 51 and the second pair of electrodes 52 and 53 are provided on the upper side of the film member 13 in the cover 12, i.e., outside the ink supply path, and the first pair of electrodes 18 and 19 and the second pair of electrodes 52 and 53 are electrically insulated from each other by insulating materials 56.

In the construction of Figure 5, as the negative pressure in the ink supply path increases, the electrically conductive upper plate 15 of the detector means 1 is first separated from the first pair of electrodes 18 and 19 and detects that the amount of remaining ink has become small.

When the negative pressure increases further, the electrically conductive stopper 51 of the detector means 2 comes into contact with the second pair of electrodes 52 and 53 and it is detected that normal printing has become impossible.

Thus, an operation similar to that of the embodiment of Figure 4 is also obtained by the ink remain detector of Figure 5, and operational effects similar to those of the embodiment of Figure 4 are obtained.

Since in the structure of Figure 5, the electrodes 52 and 53 of Figure 5 are provided outside the ink supply

path, no consideration need be paid to the contact with the ink.

According to each of the above-described embodiments, the ink remain detector 6 is provided with first detector means for detecting that the amount of ink in the ink tank 7 is small and second detector means for detecting the abnormally great negative pressure in the ink supply path and therefore, the operator of the recording apparatus can be informed of the time for interchanging the ink tank 7. Also, by endowing the second detector means with the stopper function of controlling the amount of displacement of the film member, it has become possible to prevent the film member 13 from being damaged.

Also, the amount of displacement of the film member 13 is controlled by the stopper function even when excessively great negative pressure is produced as during the ink recovering operation and therefore, the restoration of the film member 13 to its initial state after the elimination of the negative pressure has been greatly improved.

Further, by simply adding electrodes to the conventional ink remain detector, there is provided an ink remain detector conforming to the purpose of a liquid injection recording apparatus and therefore, bulkiness and increased cost of the recording apparatus can be avoided.

Also, of course, the shape, etc. of the detector means are not limited to those utilizing electrical intermittence, nor are restricted to the electrode shape shown in the above-described embodiments, but may be the most effective electrode shape in conformity with the device used, without departing from the scope of the present invention.

(Embodiment 3)

Figure 6 is a block diagram of a control system in a third embodiment of the liquid injection recording apparatus according to the present invention.

The control system of Figure 6 is of a construction in which means 35 for communicating with the atmospheric air electrically connected to the ink remain detector 6 is added to the control system of Figure 3A, and it is substantially identical in the other points to the control system of Figure 3A. In Figure 6, portions corresponding to those in Figure 3A are given similar reference numerals and need not be described.

The means 35 for communicating with the atmospheric air is means for rendering the interior of the ink remain detector 6, i.e., the hermetically sealed chamber in the body 11 partitioned by the film member 13, into the atmospheric pressure, and is designed to operate when the ink remain detector 6 detects the negative pressure for which normal printing is impossible, i.e., the abnormal negative pressure in the ink supply path.

Figure 7 shows the structure of the ink remain detector 6 used in the liquid injection recording apparatus of Figures 1A and 1B.

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The ink remain detector of Figure 7 differs from the structure of the Figure 4 embodiment in that there is added the means 35 for communicating the hermetically sealed chamber in the body 11 partitioned by the film member 13 with the atmospheric air, i.e., the means 35 for communicating with the atmospheric air comprising a port 51 for communicating with the atmospheric air and a member 52 for controlling the communication with the atmospheric air such as an opening-closing valve.

Accordingly, the ink remain detector of Figure 7 detects the negative pressure when the amount of remaining ink is small and the negative pressure for which normal printing is impossible (abnormal negative pressure) by an operation similar to that described in connection with Figure 4, as the amount of remaining ink decreases, and in addition, operates (opens) the member 52 for controlling the communication with the atmospheric air when the negative pressure for which normal printing is impossible has been reached, to thereby render the interior of the ink remain detector 6 into the atmospheric pressure.

Now, again in the ink remain detector of Figure 4, the flexible film member 13 is in its deformed state when the ink remain detector means operates, and taking the influence upon the film member into account, it is desirable that the interior of the ink remain detector be restored to the atmospheric pressure as early as possible.

So, in the embodiment of Figures 3A and 4, the negative pressure for which normal printing is impossible is detected, whereafter the atmospheric pressure is not reached until a predetermined countermeasure such as the interchange of the ink tank 7 is executed, whereas in the present embodiment (Figures 6 and 7), the atmospheric pressure is reached at a point of time whereat normal printing has become impossible and therefore, there is no necessity of fearing the above-described influence upon the film member even when the interchange of the ink tank 7 is not effected for a long period of time.

That is, according to the present embodiment, there is obtained an effect similar to that of the embodiment of Figures 3A and 4 and in addition by restoring the interior of the ink remain detector to the atmospheric pressure immediately after the detecting operation, the durability and reliability of the film member 13 and other negative-pressure-responsive members can be more improved.

(Embodiment 4)

In the liquid injection recording apparatus shown in Figures 3A and 4, the stoppage of the recording operation and the operation of communicating with the atmospheric air are effected simultaneously with the detection of negative pressure and therefore, there is the possibility that the entire recording apparatus operates by mistake due to momentary malfunctioning of the ink remain detector 6.

To prevent such inconvenience, design may be made such that the aforementioned stoppage of the recording operation and the operation of communicating with the atmospheric air are executed only when the ink remain detector 6 has continued the detecting operation for more than a predetermined time.

Figure 8 shows an embodiment of such a recording apparatus.

The control system of Figure 8 differs from the control system of Figure 6 in that a pulse width detecting circuit 36 is added between the ink remain detector 6 and the device 33 for stopping the recording operation and the means 35 for communicating with the atmospheric air.

The pulse width detecting circuit 36 outputs a drive (control signal to the device 33 for stopping the recording operation and the means 35 for communicating with the atmospheric air when a pulse having a pulse width greater than a pulse width arbitrarily set by the ink remain detector 6 is input thereto.

Thus, according to the embodiment of Figure 8, there is provided a liquid injection recording apparatus which has the operational effect obtained by the embodiment of Figure 6 and in addition, can accurately execute stable detection and information of the amount of remaining ink and the control drive necessary therefor even when momentary malfunctioning is caused in the ink remain detector 6.

In the embodiments 3 and 4 illustrated, the respective ink remain detector means are comprised of pairs of electrodes 18 and 19 and 42, 43. Also, in each embodiment illustrated, two ink remain detector means operated at different pressures are provided, but in carrying out the present invention, it is likewise possible to provide three or more ink remain detector means operated at different pressures, as required.

According to each of the above-described embodiments, two ink remain detector means operated at two negative pressures in conformity with the purposes thereof are provided and therefore, there has been provided a liquid injection recording apparatus in which effective and highly reliable detection of the amount of remaining ink can be accomplished.

Also, the recording operation is stopped when the amount of remaining ink for which normal printing is impossible has been reached and therefore, bad influence upon the recording head and the ink remain detector could be eliminated.

Further, an ink remain detector conforming to the purpose of the liquid injection recording apparatus is provided by simply adding detector means comprising electrodes to the conventional ink remain detector and therefore, bulkiness and greatly increased cost of the apparatus could be avoided.

Of course, the ink remain detector provided with ink remain detector means operated at two or more different negative pressures can be adapted to the ink remain detector of the form as shown in Figure 1B.

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As is apparent from the foregoing description, according to the present invention, there is provided a liquid injection recording apparatus provided with an ink remain detector which is simple in structure and capable of accomplishing highly reliable and moreover effective and accurate detection and information of the amount of remaining ink.

As is apparent from the foregoing description, according to the present invention, there is provided a liquid injection recording apparatus which is provided with two or more ink remain detector means operated by a variation in pressure, whereby effective and highly reliable detection of the amount of remaining ink can be accomplished.

This specification discloses a liquid injection recording apparatus having a recording head for injecting ink toward a recording medium to thereby effect recording, an ink tank storing therein the ink to be supplied to the recording head, and an ink remain detector provided half-way in a supply path communicating the recording head with the ink tank. The ink remain detector has an ink chamber having at least one wall surface thereof formed of a flexible film member, and at least two detector means responsive to the displacement of the film member.

Claims

1. A recording apparatus using a recording head (1) for discharging ink toward a recording medium to thereby effect recording and an ink tank (7) storing therein said ink to be supplied to said recording head comprising

an ink remain detector (6) for communicating said recording head (1) with said ink tank (7), said ink remain detector (6) comprising an ink chamber (26) having at least one wall surface formed by a flexible film member (13),

characterized in that

said flexible member (13) carries a first detector means (15) fixed relative to said flexible film member (13) for switching a contact means (18, 19) in accordance with a pressurization in said ink chamber (26), said contact means (18, 19) being fixed relative to said ink chamber (26),

wherein said first detector means (15) is in contact with said contact means (18, 19) until the pressure in the ink chamber (26) reaches a first set negative pressure, and said first detector means (15) is not in contact with said contact means (18, 19) upon deformation of said flexible film member (13) when the pressure in the ink chamber (26) reaches said first set negative pressure as the negative pressure in the ink chamber (26) increases, a second detector means (14) which comes into contact with stopper means (41, 42, 43) limiting a further deformation of said flexible film member (13) when the pressure in the ink chamber (26) reaches

a second set negative pressure as the negative pressure in the ink chamber (26) increases.

2. A recording apparatus according to claim 1, characterized in that said stopper means (41, 42, 43) is formed as a second contact means switchable by said second detector means (14) upon deformation greater than said deformation of said flexible film member (13) when the pressure in the ink chamber (26) reaches said second set negative pressure.
3. A recording apparatus according to claim 1 or 2, wherein said detector means (14, 15) have an electrically conductive member provided on said film member (13), and an electrode provided correspondingly to said electrically conductive member and fixed to said ink remain detector (14, 15).
4. A recording apparatus according to claim 1, further having ink remain alarm device (34) for informing of the amount of remaining ink on the basis of the result of the detection by said detector means (14, 15).
5. A recording apparatus according to claim 4, wherein said ink remain alarm device (34) has means for indicating that ink remains a little in response to at least one of said detector means (14, 15), and means for indicating ink-shortage in response to the other of said detector means (14, 15).
6. A recording apparatus according to claim 5, wherein said means for indicating that ink remains a little and said means for indicating ink-shortage are common means.
7. A recording apparatus according to claim 4, wherein said ink remain alarm device (34) has at least one means selected from among light-emitting means, sound generating means and display means.
8. A recording apparatus according to claim 4, further having means (33) for stopping the recording operation on the basis of the result of the detection by said detector means (14, 15).
9. A recording apparatus according to claim 1, further having means (35) for communicating the interior of said ink chamber (26) with the atmospheric air.
10. A recording apparatus according to claim 1, wherein said flexible film member (13) is biased by a resilient member (16) in a direction to increase the volume of said ink chamber (26).

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11. A recording apparatus according to claim 10, further having adjusting means (22) for adjusting said biasing force.

12. A recording apparatus according to claim 11, wherein said adjusting means (22) is screw means.

13. A recording apparatus according to claim 10, wherein said resilient (16) member is a spring.

14. A recording apparatus according to claim 1, characterized in that said stopper means (41, 42, 43) for controlling the amount of displacement of said flexible film member (13) are formed in said ink chamber (26).

15. A recording apparatus according to claim 1, characterized in that said stopper means are provided outside of said ink chamber (26).

16. An ink remain detecting apparatus provided with an inflow port (24), an outflow port (25) and an ink chamber (26) communicating with said inflow port (24) and said outflow port (25) and having at least one wall surface formed by a flexible film member (13),

characterized in that

said flexible film member (13) carries a first detector means (15) fixed relative to said flexible film member (13) for switching a contact means (18, 19) in accordance with a pressurization in said ink chamber (26), said contact means (18, 19) being fixed relative to said ink chamber (26),

wherein said first detector means (15) is in contact with said contact means (18, 19) until the pressure in the ink chamber (26) reaches a first set negative pressure, and said first detector means (15) is not in contact with said contact means (18, 19) upon deformation of said flexible film member (13) when the pressure in the ink chamber (26) reaches said first set negative pressure as the negative pressure in the ink chamber (26) increases, a second detector means (14) which comes into contact with stopper means (41, 42, 43) limiting a further deformation of said flexible film member (13) when the pressure in the ink chamber (26) reaches a second set negative pressure as the negative pressure in the ink chamber (26) increases.

17. An ink remain detecting apparatus according to claim 16, characterized in that said stopper means (41, 42, 43) is formed as a second contact means switchable by said second detector means (14) upon deformation greater than said deformation of said flexible film member (13) when the pressure in the ink chamber (26) reaches said second set negative pressure.

18. An ink remain detector according to claim 16 or 17, further having means (35) for communicating the interior of said ink chamber (26) with the atmospheric air.

19. An ink remain detector according to claim 16 or 17, wherein said flexible film member (13) is biased by a resilient member (16) in a direction to increase the volume of said ink chamber (26).

20. An ink remain detector according to claim 19, further having adjusting means (22) for adjusting said biasing force.

21. An ink remain detector according to claim 20, wherein said adjusting means (22) is a screw means.

22. An ink remain detector according to claim 16, characterized in that said stopper means (41, 42, 43) for limiting the amount of movement of said flexible film member (13) are provided in said ink chamber (26).

23. An ink remain detector according to claim 19, wherein said resilient means (16) is a spring.

24. An ink remain detector according to claim 16, wherein said flexible film member (13) is in a substantially undisplaced state when said first detector means (15) and said contact means (18, 19) are in contact with each other.

Patentansprüche

1. Aufzeichnungsvorrichtung, die einen Aufzeichnungskopf(1) zum Ausströmen von Tinte auf ein Aufzeichnungsmedium, um dadurch ein Aufzeichnen zu bewirken und einen Tintenbehälter (7) verwendet, in dem die zum Aufzeichnungskopf zu fördernde Tinte bevorratet ist, mit:
einem Detektor für verbleibende Tinte (6), um den Aufzeichnungskopf (1) mit dem Tintenbehälter (7) zu verbinden, wobei der Detektor für verbleibende Tinte (6) eine Tintenkommer (26) hat, die mit wenigstens einer durch ein flexibles Filmbauteil (13) gebildete Wandfläche versehen ist,
dadurch gekennzeichnet, daß
das flexible Bauteil (13) eine erste Detektoreinrichtung (15) trägt, die relativ zum flexiblen Filmbauteil (13) befestigt ist um eine Kontakteinrichtung (18, 19) in Abhängigkeit einer Druckbeaufschlagung der Tintenkommer (26) zu schalten, wobei die Kontakteinrichtung (18, 19) relativ zur Tintenkommer (26) befestigt ist,
wobei die erste Detektoreinrichtung (15) in Kontakt mit der Kontakteinrichtung (18, 19) ist, bis der Druck in der Tintenkommer (26) einen ersten eingestellten Unterdruck erreicht, und während der in

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- der Tintenammer (26) herrschende Unterdruck ansteigt, die erste Detektoreinrichtung (15) auf eine Verformung des flexiblen Filmbauteils (13) hin, nicht in Kontakt mit der Kontakteinrichtung (18, 19) ist, wenn der in der Tintenammer (26) herrschende Druck den ersten bestimmten Unterdruck erreicht, und einer zweiten Detektoreinrichtung (14), die, während der in der Tintenammer (26) herrschende Unterdruck ansteigt, in Kontakt mit einer Anschlag-einrichtung (41, 42, 43) kommt, die eine weitere verformung des flexiblen Filmbauteils (13) begrenzt, wenn der Druck in der Tintenammer (26) einen zweiten bestimmten Unterdruck erreicht.
2. Aufzeichnungsvorrichtung nach Anspruch 1, **dadurch gekennzeichnet**, daß die Anschlag-einrichtung (41, 42, 43) als eine zweite Kontakteinrichtung ausgebildet ist, die durch die zweite Detektoreinrichtung (14) auf eine Verformung hin schaltbar ist, die größer als die Verformung des flexiblen Filmbauteils (13) ist, wenn der Druck in der Tintenammer (26) das zweite bestimmte Unterdruckniveau erreicht.
 3. Aufzeichnungsvorrichtung nach Anspruch 1 oder 2, wobei die Detektoreinrichtung (14, 15) ein elektrisch leitendes Bauteil hat, das am Filmbauteil (13) vorgesehen ist, und eine Elektrode hat, die entsprechend dem elektrisch leitenden Bauteil vorgesehen ist und am Detektor für verbleibende Tinte (14, 15) befestigt ist.
 4. Aufzeichnungsvorrichtung nach Anspruch 1 mit weiterhin einer Alarmeinrichtung (34) für verbleibende Tinte, um über den Betrag der verbleibenden Tinte auf der Basis des Ergebnisses der Erfassung durch die Detektoreinrichtung (14, 15) zu informieren.
 5. Aufzeichnungsvorrichtung nach Anspruch 4, wobei die Alarmeinrichtung (34) für verbleibende Tinte eine Einrichtung zum Anzeigen, daß Tinte in Reaktion auf wenigstens einem der Detektoreinrichtungen (14, 15) geringfügig verbleibt, und eine Einrichtung hat, zum Anzeigen von Tintenknappheit in Reaktion auf der anderen der Detektoreinrichtungen (14, 15).
 6. Aufzeichnungsvorrichtung nach Anspruch 5, wobei die Einrichtung zum Anzeigen, daß Tinte geringfügig verbleibt und die Einrichtung zum Anzeigen der Tintenknappheit gemeinsam ausgebildet sind.
 7. Aufzeichnungsvorrichtung nach Anspruch 4, wobei die Alarmeinrichtung (34) für verbleibende Tinte wenigstens über eine der Einrichtungen Lichtaus-sende-einrichtung, Tonerzeugungseinrichtung oder Anzeigeeinrichtung verfügt.
 8. Aufzeichnungsvorrichtung nach Anspruch 4, mit weiterhin einer Einrichtung (33) zum Anhalten des Aufzeichnungsvorgangs auf der Basis des Ergebnisses der Erfassung durch die Detektoreinrichtung (14, 15).
 9. Aufzeichnungsvorrichtung nach Anspruch 1, mit weiterhin einer Einrichtung (35) zum Verbinden des Inneren der Tintenammer (26) mit der atmosphärischen Luft.
 10. Aufzeichnungsvorrichtung nach Anspruch 1, wobei das flexible Filmbauteil (13) durch ein elastisches Bauteil (16) in eine Richtung vorgespannt ist, um das Volumen der Tintenammer (26) zu vergrößern.
 11. Aufzeichnungsvorrichtung nach Anspruch 10, mit weiterhin einer Einstelleinrichtung (22) zum Einstellen der Vorspannkraft.
 12. Aufzeichnungsvorrichtung nach Anspruch 11, wobei die Einstelleinrichtung (22) eine Schraubeneinrichtung ist.
 13. Aufzeichnungsvorrichtung nach Anspruch 10, wobei das elastische Bauteil (16) eine Feder ist.
 14. Aufzeichnungsvorrichtung nach Anspruch 1, **dadurch gekennzeichnet**, daß die Anschlag-einrichtung (41, 42, 43) zum Steuern des Betrags der Verschiebung des flexiblen Filmbauteils (13) in der Tintenammer (26) ausgebildet ist.
 15. Aufzeichnungsvorrichtung nach Anspruch 1, **dadurch gekennzeichnet**, daß die Anschlag-einrichtung außerhalb der Tintenammer (26) vorgesehen ist.
 16. Detektorvorrichtung für verbleibende Tinte mit: einer Einströmöffnung (24), einer Ausströmöffnung (25) und einer Tintenammer (26), die in Verbindung mit der Einströmöffnung (24) und der Ausströmöffnung (25) ist, und die wenigstens eine Wandfläche hat, die durch ein flexibles Filmbauteil (13) ausgebildet ist, **dadurch gekennzeichnet**, daß das flexible Bauteil (13) eine erste Detektoreinrichtung (15) trägt, die relativ zum flexiblen Filmbauteil (13) befestigt ist um eine Kontakteinrichtung (18, 19) in Abhängigkeit einer Druckbeaufschlagung der Tintenammer (26) zu schalten, wobei die Kontakteinrichtung (18, 19) relativ zur Tintenammer (26) befestigt ist, wobei die erste Detektoreinrichtung (15) in Kontakt mit der Kontakteinrichtung (18, 19) ist, bis der Druck in der Tintenammer (26) einen ersten eingestellten Unterdruck erreicht, und während der in der Tintenammer (26) herrschende Unterdruck

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ansteigt, die erste Detektoreinrichtung (15) auf eine Verformung des flexiblen Filmbauteils (13) hin, nicht in Kontakt mit der Kontakteinrichtung (18, 19) ist, wenn der in der Tintenkammer (26) herrschende Druck den ersten bestimmten Unterdruck erreicht, und

einer zweiten Detektoreinrichtung (14), die, während der in der Tintenkammer (26) herrschende Unterdruck ansteigt, in Kontakt mit einer Anschlageinrichtung (41, 42, 43) kommt, die eine weitere Verformung des flexiblen Filmbauteils (13) begrenzt, wenn der Druck in der Tintenkammer (26) einen zweiten bestimmten Unterdruck erreicht.

17. Aufzeichnungsvorrichtung nach Anspruch 16, **dadurch gekennzeichnet**, daß die Anschlageinrichtung (41, 42, 43) als eine zweite Kontakteinrichtung ausgebildet ist, die durch die zweite Detektoreinrichtung (14) auf eine Verformung hin schaltbar ist, die größer als die Verformung des flexiblen Filmbauteils (13) ist, wenn der Druck in der Tintenkammer (26) das zweite bestimmte Unterdruckniveau erreicht.
18. Aufzeichnungsvorrichtung nach Anspruch 16 oder 17, mit weiterhin einer Einrichtung (35) zum Verbinden des Inneren der Tintenkammer (26) mit der atmosphärischen Luft.
19. Aufzeichnungsvorrichtung nach Anspruch 16 oder 17, wobei das flexible Filmbauteil (13) durch ein elastisches Bauteil (16) in eine Richtung vorgespannt ist, um das Volumen der Tintenkammer (26) zu vergrößern.
20. Aufzeichnungsvorrichtung nach Anspruch 19, mit weiterhin einer Einstelleinrichtung (22) zum Einstellen der Vorspannkraft.
21. Aufzeichnungsvorrichtung nach Anspruch 12, wobei die Einstelleinrichtung (22) eine Schraubeneinrichtung ist.
22. Aufzeichnungsvorrichtung nach Anspruch 16, **dadurch gekennzeichnet**, daß die Anschlageinrichtung (41, 42, 43) zum Begrenzen des Betrags der Bewegung des flexiblen Filmbauteils (13) in der Tintenkammer (26) ausgebildet ist.
23. Aufzeichnungsvorrichtung nach Anspruch 19, wobei das elastische Bauteil (16) eine Feder ist.
24. Detektorvorrichtung für verbleibende Tinte nach Anspruch 16, wobei das flexible Filmbauteil (13) in einem im wesentlichen unverschobenen Zustand ist, wenn die erste Detektoreinrichtung (15) und die Kontakteinrichtung (18, 19) miteinander in Kontakt sind.

Revendications

1. Appareil d'enregistrement utilisant une tête d'enregistrement (1) destinée à décharger de l'encre vers un support d'enregistrement pour effectuer ainsi un enregistrement, et un réservoir d'encre (7) dans lequel est emmagasinée ladite encre devant être fournie à ladite tête d'enregistrement, comportant un détecteur (6) d'encre restante destiné à faire communiquer ladite tête d'enregistrement (1) avec ledit réservoir d'encre (7), ledit détecteur (6) d'encre restante comportant une chambre à encre (26) ayant au moins une surface de paroi formée par un élément en film flexible (13), caractérisé en ce que
 ledit élément flexible (13) porte un premier moyen détecteur (15) fixe par rapport audit élément à film flexible (13) de façon à commuter un moyen de contact (18, 19) conformément à l'établissement d'une pression dans ladite chambre à encre (26), ledit moyen de contact (18, 19) étant fixe par rapport à ladite chambre à encre (26),
 dans lequel ledit premier moyen détecteur (15) est en contact avec ledit moyen de contact (18, 19) jusqu'à ce que la pression dans la chambre à encre (26) atteigne une première pression négative de réglage, et ledit premier moyen détecteur (15) n'est pas en contact avec ledit moyen de contact (18, 19) lors d'une déformation dudit élément à film flexible (13) lorsque la pression dans la chambre à encre (26) atteint ladite première pression négative de réglage alors que la pression négative dans la chambre à encre (26) augmente,
 un second moyen détecteur (14) qui vient en contact avec des moyens d'arrêt (41, 42, 43) limitant la poursuite de la déformation dudit élément à film flexible (13) lorsque la pression dans la chambre à encre (26) atteint une seconde pression négative de réglage alors que la pression négative dans la chambre à encre (26) s'élève.
2. Appareil d'enregistrement selon la revendication 1, caractérisé en ce que
 lesdits moyens d'arrêt (41, 42, 43) sont réalisés sous la forme d'un second moyen de contact pouvant être commuté par ledit second moyen détecteur (14) lors d'une déformation supérieure à ladite déformation dudit élément à film flexible (13) lorsque la pression dans la chambre à encre (26) atteint ladite seconde pression négative de réglage.
3. Appareil d'enregistrement selon la revendication 1 ou 2, dans lequel lesdits moyens détecteurs (14, 15) ont un élément électriquement conducteur situé sur ledit élément à film (13), et une électrode prévue de façon à correspondre audit élément électriquement conducteur et fixée audit détecteur (14, 15) d'encre restante.

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4. Appareil d'enregistrement selon la revendication 1, comportant en outre un dispositif (34) d'alarme d'encre restante destiné à informer de la quantité d'encre restante sur la base du résultat de la détection par lesdits moyens détecteurs (14, 15).
5. Appareil d'enregistrement selon la revendication 4, dans lequel ledit dispositif d'alarme (34) d'encre restante comporte un moyen destiné à indiquer qu'il reste peu d'encre en réponse à au moins l'un desdits moyens détecteurs (14, 15), et un moyen destiné à indiquer un épuisement de l'encre en réponse à l'autre desdits moyens détecteurs (14, 15).
6. Appareil d'enregistrement selon la revendication 5, dans lequel ledit moyen destiné à indiquer qu'il reste peu d'encre et ledit moyen destiné à indiquer un épuisement de l'encre sont des moyens communs.
7. Appareil d'enregistrement selon la revendication 4, dans lequel ledit dispositif d'alarme (34) d'encre restante comporte au moins un moyen choisi parmi un moyen d'émission de lumière, un moyen génération de son et un moyen d'affichage.
8. Appareil d'enregistrement selon la revendication 4, comportant en outre un moyen (33) destiné à arrêter l'opération d'enregistrement sur la base du résultat de la détection par lesdits moyens détecteurs (14, 15).
9. Appareil d'enregistrement selon la revendication 1, comportant en outre un moyen (35) destiné à faire communiquer l'intérieur de ladite chambre à encre (26) avec l'air atmosphérique.
10. Appareil d'enregistrement selon la revendication 1, dans lequel ledit élément à film flexible (13) est rappelé par un élément élastique (16) dans un sens augmentant le volume de ladite chambre à encre (26).
11. Appareil d'enregistrement selon la revendication 10, comportant en outre un moyen de réglage (22) destiné à régler ladite forme de rappel.
12. Appareil d'enregistrement selon la revendication 11, dans lequel ledit moyen de réglage (22) est un moyen à vis.
13. Appareil d'enregistrement selon la revendication 10, dans lequel ledit élément élastique (16) est un ressort.
14. Appareil d'enregistrement selon la revendication 1, caractérisé en ce que lesdits moyens d'arrêt (41, 42, 43) destinés à limiter l'amplitude du déplacement dudit élément à film flexible (13) sont formés dans ladite chambre à encre (26).
15. Appareil d'enregistrement selon la revendication 1, caractérisé en ce que lesdits moyens d'arrêt sont prévus à l'extérieur de ladite chambre à encre (26).
16. Appareil de détection d'encre restante pourvu d'un orifice d'entrée (24), d'un orifice de sortie (25) et d'une chambre à encre (26) communiquant avec ledit orifice d'entrée (24) et ledit orifice de sortie (25) et ayant au moins une surface de paroi formée par un élément à film flexible (13), caractérisé en ce que ledit élément à film flexible (13) porte un premier moyen détecteur (15) fixe par rapport audit élément à film flexible (13) pour commuter un moyen de contact (18, 19) en fonction de l'établissement d'une pression dans ladite chambre à encre (26), ledit moyen de contact (18, 19) étant fixe par rapport à ladite chambre à encre (26), dans lequel ledit premier moyen détecteur (15) est en contact avec ledit moyen de contact (18, 19) jusqu'à ce que la pression dans la chambre à encre (26) atteigne une première pression négative de réglage, et ledit premier moyen détecteur (15) n'est pas en contact avec ledit moyen de contact (18, 19) lors d'une déformation dudit élément à film flexible (13) lorsque la pression dans la chambre à encre (26) atteint ladite première pression négative de réglage alors que la pression négative dans la chambre à encre (26) s'élève, un second moyen détecteur (14) qui vient en contact avec des moyens d'arrêt (41, 42, 43) limitant la poursuite de la déformation dudit élément à film flexible (13) lorsque la pression dans la chambre à encre (26) atteint une seconde pression négative de réglage alors que la pression négative dans la chambre à encre (26) augmente.
17. Appareil de détection d'encre restante selon la revendication 16, caractérisé en ce que lesdits moyens d'arrêt (41, 42, 43) sont réalisés sous la forme d'un second moyen de contact pouvant être commuté par ledit second moyen détecteur (14) lors d'une déformation supérieure à ladite déformation dudit élément à film flexible (13) lorsque la pression dans la chambre à encre (26) atteint ladite seconde pression négative de réglage.
18. Détecteur d'encre restante selon la revendication 16 ou 17, comportant en outre un moyen (35) destiné à faire communiquer l'intérieur de ladite chambre à encre (26) avec l'air atmosphérique.

19. Détecteur d'encre restante selon la revendication
16 ou 17, dans lequel ledit élément à film flexible
(13) est rappelé par un élément élastique (16) dans
un sens augmentant le volume de ladite chambre à
encre (26). 5
20. Détecteur d'encre restante selon la revendication
19, comportant en outre un moyen de réglage (22)
destiné à régler ladite force de rappel. 10
21. Détecteur d'encre restante selon la revendication
12, dans lequel ledit moyen de réglage (22) est un
moyen à vis.
22. Détecteur d'encre restante selon la revendication 15
16, caractérisé en ce que
 lesdits moyens d'arrêt (41, 42, 43) destinés à
limiter l'amplitude du mouvement dudit élément à
film flexible (13) sont prévus dans ladite chambre à
encre (26). 20
23. Détecteur d'encre restante selon la revendication
19, dans lequel ledit moyen élastique (16) est un
ressort. 25
24. Détecteur d'encre restante selon la revendication
16, dans lequel ledit élément à film flexbile (13) est
dans un état sensiblement non déplacé lorsque
ledit premier moyen détecteur (15) et ledit moyen
de contact (18, 19) sont en contact l'un avec l'autre. 30

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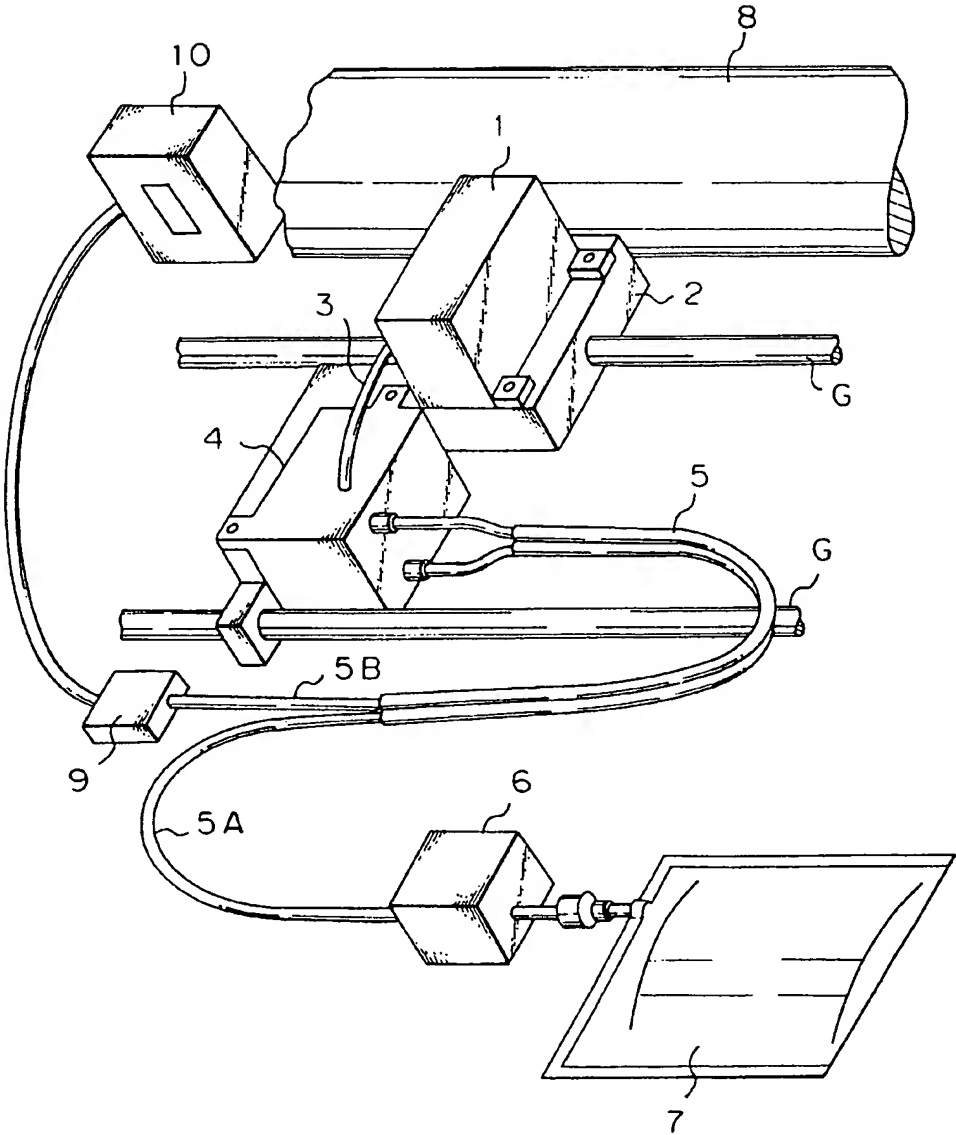
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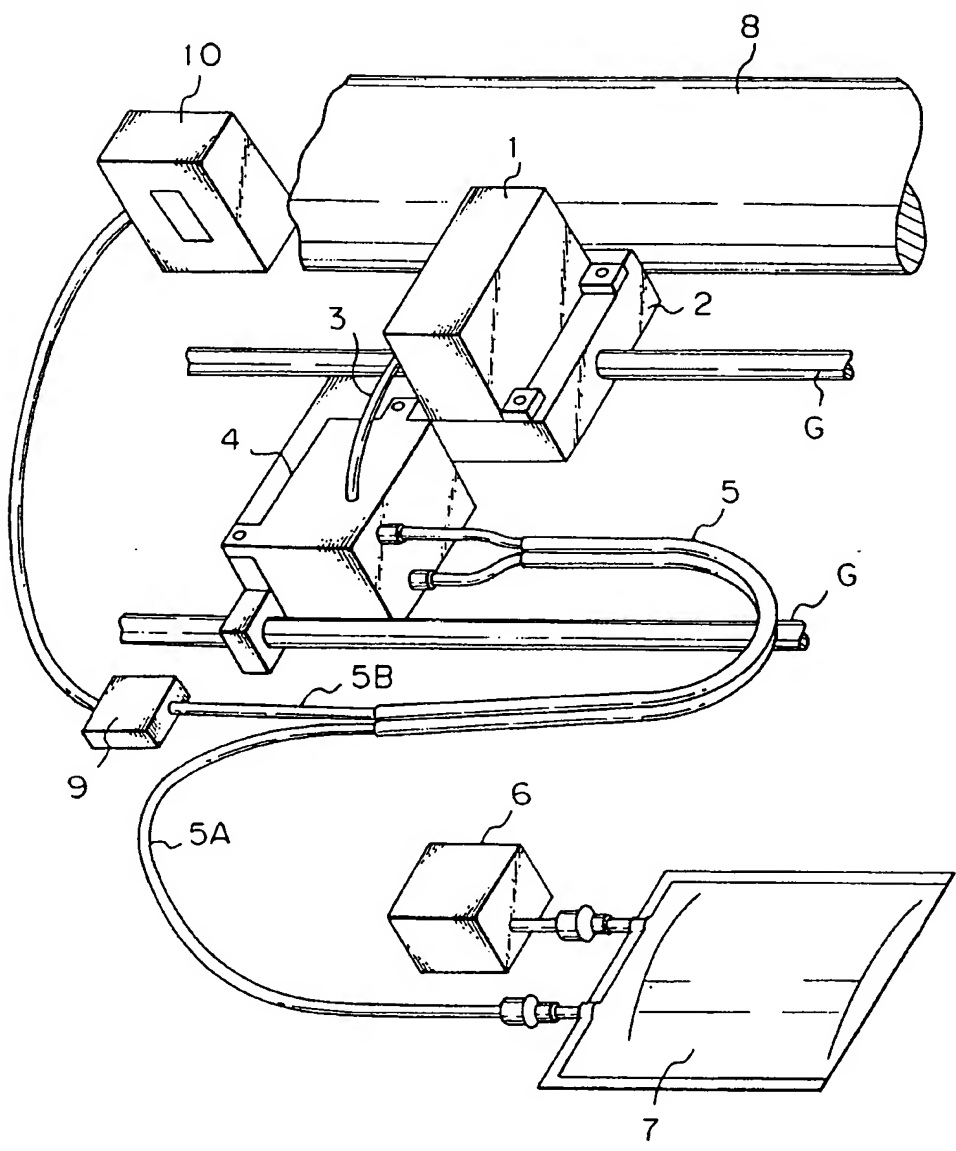
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Fig. 1 A



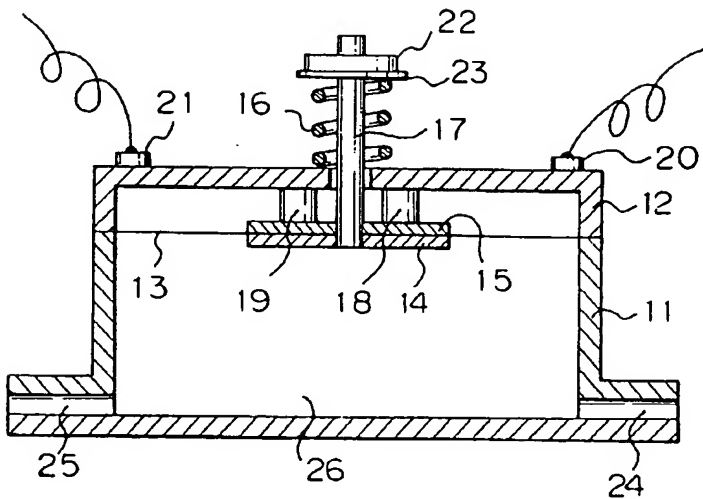
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Fig. 1B



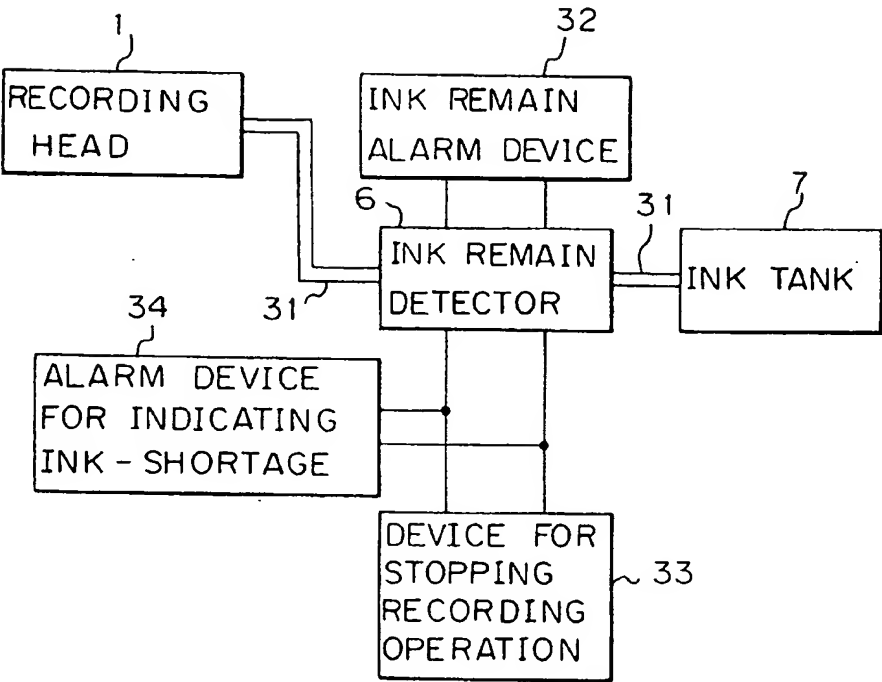
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Fig. 2

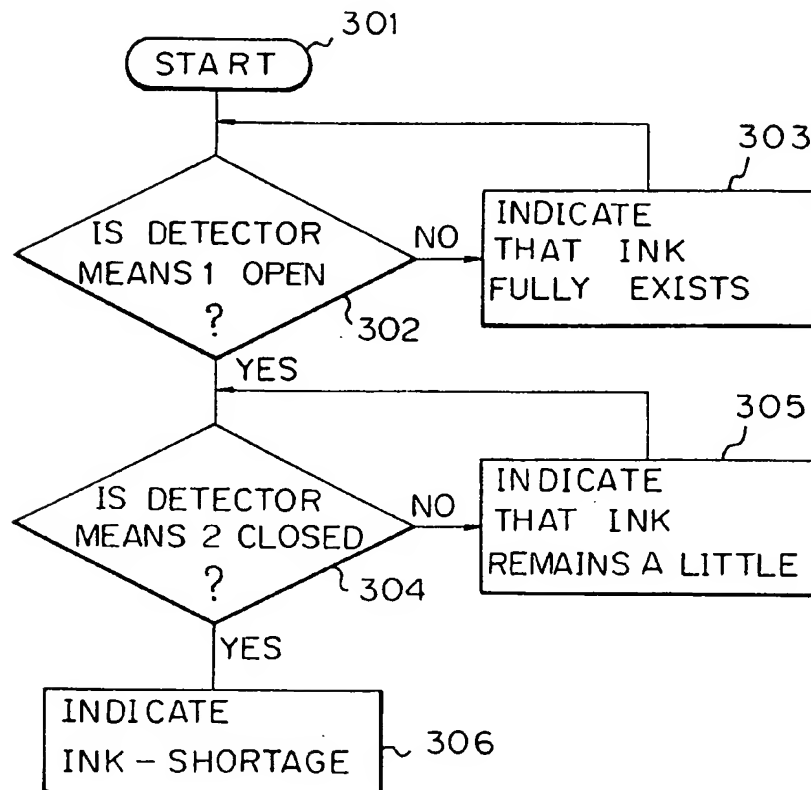


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Fig. 3 A



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Fig. 3 B

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Fig. 4

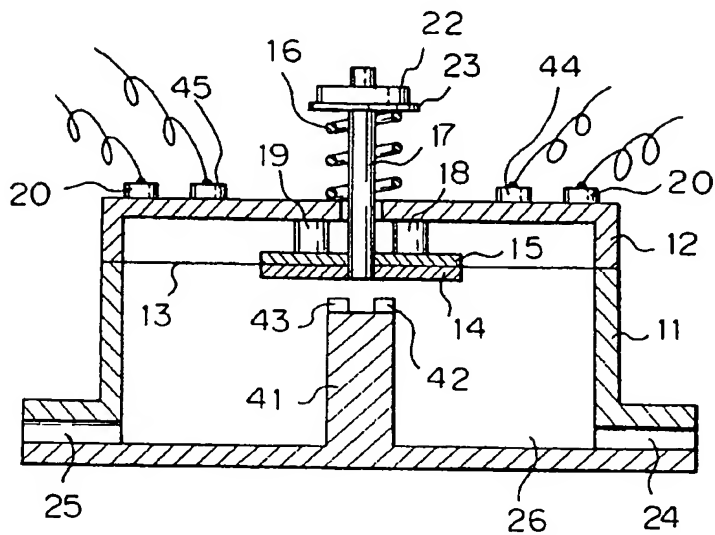
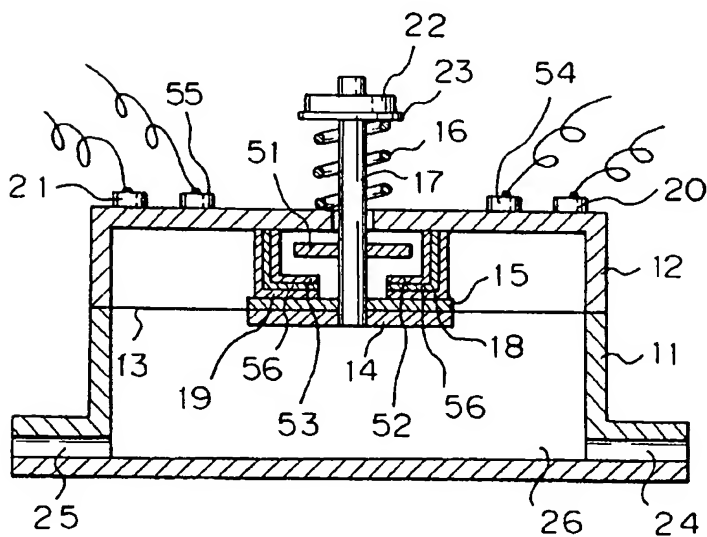


Fig. 5



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Fig. 6

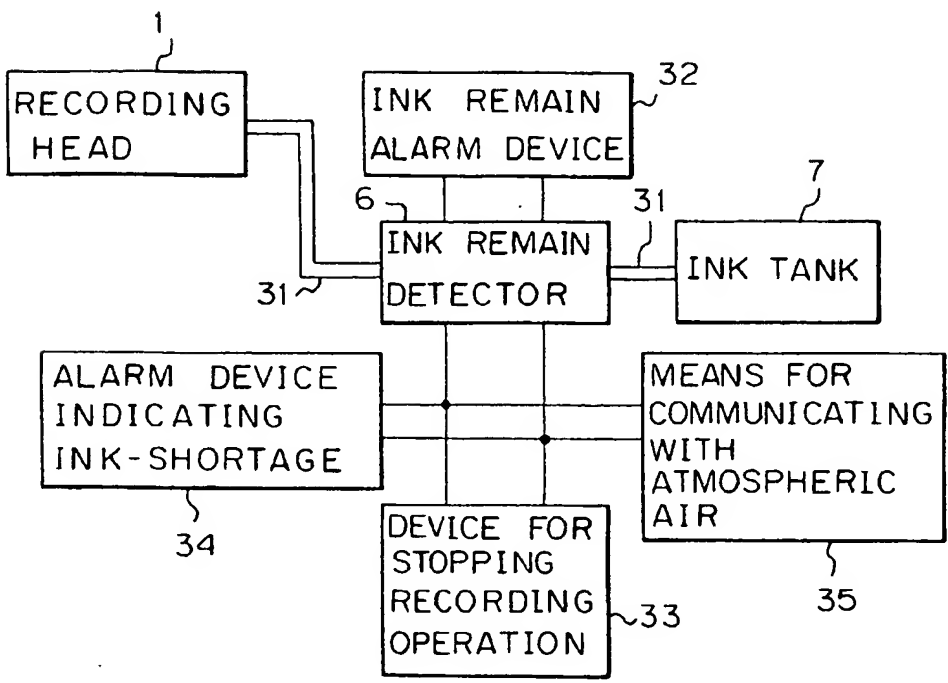
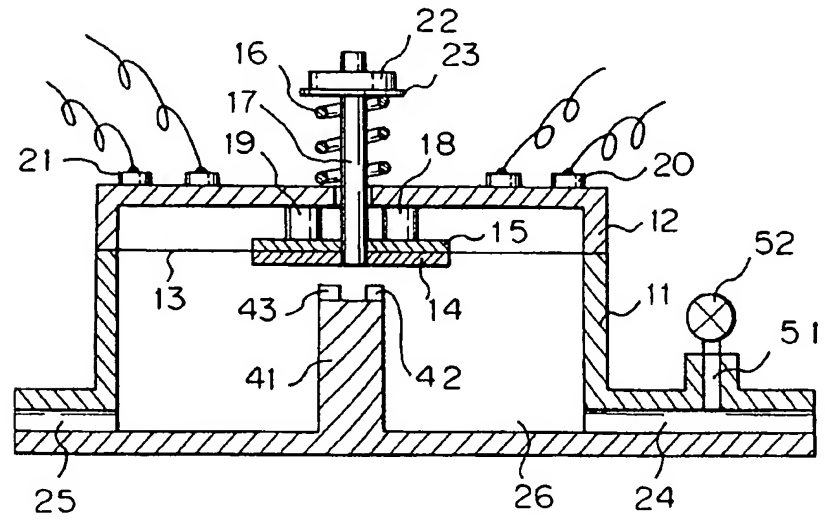


Fig. 7



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Fig. 8

